Canad. M. A. J.
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OBNEY: HYDROCELES   733

HYDROCELES OF THE TESTICLE COMPLICATING INGUINAL HERNIAS*

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HYDROCELES OF THE TESTICLE are frequently associated with inguinal hernias and should be included in the surgical treatment of that type of hernia. This prompted us to undertake the study of a series of cases (1,248 or 8.6% of 14,442 inguinal hernias) operated on at Shouldice Surgery over a period of 10 years (July 1945 to August 6, 1955). Only cases where the testicle was brought into the operation were considered.

ANATOMY OF THE LYMPHATIC SYSTEM OF TESTICLE AND CORD

A brief review of the anatomy of the lymphatic system of the testicle and cord is essential at this point. The parietal tunica vaginalis of the testicle contains a lymphatic plexus comparable to the subserous plexus of the diaphragm and intercostal pleura. These lymphatic plexuses are buried within the basal fibrous layer of the parietal tunica vaginalis propria. Each plexus consists of a deep and superficial portion, the superficial plexus lying in direct contact with the endothelial lining of the sac. The efferent lymphatics of the tunica vaginalis course around the parietal tunica vaginalis. The lymphatic absorption of fluid from the sac and its flow along the efferent channels are essentially similar to the lymphatic absorption from other serous cavities in the body.

All the lymphatic trunks of the testicle and its tunica vaginalis eventually arrive at the posterosuperior border of the organ.[1] They leave this border by ascending and anastomosing along the blood vessels of the spermatic cord. In the cord the lymphatics are generally placed more superficially than the blood vessels to which they are closely applied. Their number varies from four to eight.

HYDROCELES NOT COMPLICATED BY HERNIA

Of 1,248 operations analyzed, only 61 hydroceles were not associated with inguinal hernias. Of these 61 hydroceles, 8.5% were bilateral and

91.5% were unilateral. Hydroceles were found to be more frequent on the right side than on the left side in the ratio of 5 to 3. Most hydroceles appeared in the older age group.

Treatment of simple hydroceles was entirely surgical. The testicle along with the hydrocele was brought to the surface through a low inguinal incision without disturbing the anatomy of that region, since no inguinal hernias were present. The tunica vaginalis was excised close to the testicle and the cut edges of the tunica vaginalis were oversewn with continuous catgut or wire sutures. Additional bleeding was usually stopped with wire or catgut ligatures. The testicle was then replaced in the scrotum and the wound closed. The scrotal approach was not used. Drainage tubes were unnecessary but perfect hæmostasis had to be obtained.

Complications

There was one moderately severe hæmorrhage into the scrotum after a hydrocele operation. This was treated expectantly. The hæmatoma was gradually absorbed over a period of weeks. The testicle survived.

HYDROCELES ASSOCIATED WITH HERNIA

There were 730 hydroceles (5.05% of 14,442) associated with inguinal hernias. Most hydroceles associated with hernias appeared in the older age group and the majority appeared in the sixth decade (see Table I). The percentage gradually tapered off towards older and younger age groups. Only 2.9% appeared in the ninth decade. Hydroceles associated with inguinal hernias were more frequent on the right side than on the left side in the ratio of 5 to 3.

Hydroceles masking a hernia

A large hydrocele may obscure an inguinal hernia and present a problem preoperatively. The question arises whether a hydrocele alone should be operated on or the inguinal region explored as well. If the hydrocele is very large, it may extend into the inguinal region as far as the external ring and make it impossible to diagnose a hernia preoperatively. Under these circumstances the hydrocele should be drained and the patient re-examined for hernia before the operation.

In 35 cases diagnosed as hydroceles preoperatively the inguinal region was explored sur-

TABLE I.

PRIMARY HYDROCELES: AGE INCIDENCE

Decade	No. of cases	Percentage
1st	23	2.9%
2nd	35	4.4%
3rd	51	6.5%
4th	107	13.6%
5th	134	17.0%
6th	184	23.0%
7th	171	21.6%
8th	80	10.2%
9th	6	.8%
	791	100.0%

gically and a hernia was discovered in 22 cases (62.8% of 35); these would otherwise have been missed. There were 5 direct and 17 indirect hernias in this group.

Treatment

The treatment of hydroceles associated with inguinal hernias was entirely surgical. The method employed was the same as that described for uncomplicated hydroceles, except that the inguinal hernia was repaired also.

Complications

(a) *Hæmorrhage.* Hæmorrhage during a combined hernia and hydrocele operation was a more difficult problem than in operation for simple hydrocele. There were 14 cases (1.9%) of moderately severe postoperative hæmorrhage into the scrotum. One case was operated on later, the blood clot evacuated and the testicle removed. The other 13 cases were permitted to make a slow recovery. Weeks were required before the hæmatoma was absorbed to the satisfaction of the patient. Drainage tubes were never used.

(b) *Orchidectomies.* When hæmorrhage around the testicle could not be successfully con-

TABLE II.

	No. of cases	Percentage
Total number of inguinal hernias...	14,442	
Total cases analyzed..............	1,248	8.64%
Hydroceles associated with inguinal hernias......................	730	5.05%
Tunica vaginalis partly excised— no hydrocele present...........	316	2.19%
Post-herniorraphy hydroceles......	141	0.98%
Hydroceles alone.................	61	0.42%
	1,248	8.64%

trolled, the testicle was sacrificed. Twenty-one testicles (2.8% of 730) had to be removed.

(c) *Atrophy of testicle.* Nine testicles atrophied (1.2% of 730) following combined hernia and hydrocele operations.

(d) *Infection.* Four cases (0.55% of 730) of infection around the testicle followed the combined operations.

(e) *Sloughing of scrotum.* Three patients (0.3%) had varying degrees of sloughing of the scrotum after the combined operations without coincidental wound infection. Sloughing of the scrotum was noted in cases where the testicle had been placed between the fascial layers and the skin on the supposition that these layers of fascia were the cause of recurrence of a hydrocele.

SIMPLE HYDROCELES FOLLOWING HERNIA OPERATIONS

In 14,442 inguinal hernia operations there were 141 (0.9%) post-herniorraphy hydroceles in cases where there was no evidence of a hydrocele preoperatively. The greatest number of postoperative hydroceles was recorded in the year 1948 (see Table III). Of 787 inguinal hernia

TABLE III.

POSTOPERATIVE HYDROCELES BY YEARS

Year	Total hernia operations	Total no. of Post-herniorraphy hydroceles	Percentage
1942 to 1945	454	1	0.22%
1946	544	6	1.10%
1947	635	5	0.79%
1948	787	18	2.28%
1949	1050	16	1.52%
1950	1215	16	1.31%
1951	1460	14	0.96%
1952	1817	10	0.55%
1953	2280	34	1.49%
1954	2469	18	0.73%
1955 (Aug. 6, 1955)	1731	6	0.35%

operations performed during that year 18 (2.28%) were of this type of post-herniorraphy hydrocele. During that year the spermatic cord was stripped of its fat and the internal and external rings were made quite snug. This procedure apparently not only damaged the lymphatics in the spermatic cord but also constricted those that remained undamaged to such an extent that lymphatic drainage was retarded. This mistake was discovered and corrected during the same year and the incidence of post-hernior-

Canad. M. A. J.
Nov. 1, 1956, vol. 75

OBNEY: HYDROCELES 735

raphy hydroceles decreased, so that there were only 18 (0.7%) such hydroceles in 2,469 inguinal hernia operations performed in the year 1954.

Prevention of postoperative hydrocele

(a) *Lymphatic drainage.* Abstain from damaging the lymphatics by an over-zealous excision of the fat along the spermatic cord. Similar damage can be produced by clumsy ligatures which catch the lymphatics and thus obstruct them. Careful and neat hæmostasis without unnecessary damage to the lymphatics is therefore imperative. There should be no blunt dissection with gauze sponges. Blood vessels between the hernia sac and the spermatic cord should be carefully clamped, divided and tied but not torn off, necessitating clamping part of the cord to stop the hæmorrhage.

(b) *Tunica vaginalis.* Wide excision of tunica vaginalis is also essential in cases where a combined hydrocele and inguinal hernia operation is performed. Where there is no evidence of pre-existing hydrocele, the tunica vaginalis should be left intact. Partial excision of the tunica vaginalis is useless. In our effort to eliminate postoperative hydroceles, all testicles were examined during hernia operations for a period of two years (1948-49). If there was the slightest increase in the amount of fluid around the testicle, the tunica vaginalis was partly excised. This procedure was carried out in 316 hernia operations where there was no accompanying preoperative hydrocele, and in this group there were 6 (1.8%) postoperative hydroceles. Partial excision of the tunica vaginalis was not the solution to the problem and this simple procedure was therefore discontinued. Since then, unless there is definite excess of fluid, the tunica vaginalis has been left intact.

Treatment

Three methods of treatment of post-herniorraphy hydrocele have been carried out.

(a) *Surgery.* Eleven postoperative hydroceles (8.15% of 141) were operated on with excellent results. Tunica vaginalis was almost totally excised. The tunica vaginalis increases in vascularity with its proximity to the testicle; therefore the more tunica vaginalis is excised, the more hæmorrhage is encountered.

(b) *Repeated aspiration.* Twenty-seven (19.44%) of 141 were tapped from one to three times. In this group there were 8 cures (29.6%) and 19 failures (70.4%).

(c) *Aspiration with injection of quinine and urethane.* In 6 out of 9 (66%) cases drainage and injection with quinine and urethane solution gave good results. Injection treatment was instituted only at the beginning of 1953, and the series is too small as yet to draw any definite conclusions. However, injection treatment was successful in at least 66% of this group.

RECURRENT HYDROCELES

A recurrent hydrocele is one in which fluid reforms round the testicle within an endothelial membrane after surgical removal of a hydrocele. Forty-four hydroceles out of the total of 730 operated on at the time of the hernia operation recurred (a rate of 6.0%). One recurrence was recorded in 1946 and 7 were recorded in 1952. The recurrence rate, however, decreased from 20% (10 out of 50) in 1948 to 2.4% (3 out of 123) in 1954 because of changes in operative procedure.

Treatment

(a) *Surgery.* Eight cases (17.6% of 44) were operated on with good results. Tunica vaginalis which reformed round a closed cavity was almost completely excised.

(b) *Aspiration.* Six cases were simply drained with good results. The remaining cases were symptom-free and therefore not treated at all.

DISCUSSION

The most interesting observation is that there were no recurrences of uncomplicated hydroceles after their removal surgically but that there was a recurrence rate of 8.7% in hydroceles associated with inguinal hernias. The operation for inguinal hernia therefore had a tendency to produce postoperative hydrocele.

A hydrocele may be produced in three ways: (1) By interference with the absorption of hydrocele fluid by the tunica vaginalis. (2) By interference with drainage of fluid along the lymphatics of the cord. (3) By excess production of fluid within the tunica vaginalis. Experimental work of Allen[2] and of Huggins and Entz[3] has indicated that hydroceles are due to a defective mechanism for absorption of fluid from the tunica vaginalis cavity rather than to hypersecretion of fluid by the tunica vaginalis itself.

Hydrocele formation after hernia operations can be explained by the fact that extensive

dissection with resultant multiple ligatures along the cord, in order to obtain hæmostasis, can easily interfere with the lymphatics of the cord and consequently obstruct drainage of the fluid normally present in the tunica vaginalis. If the bleeding points are ligated, care must be taken not to pick up more tissue than is necessary in each ligature. Extensive excision of fat within the internal spermatic fascia will similarly destroy the lymphatics in the cord, interfering with drainage. A similar condition may be produced when the spermatic cord is constricted at the rings, after hernia repair. The lymphatics may become so engorged during an operation that they can be readily seen with the naked eye.

In cases where a congenital hernia sac is continuous with the tunica vaginalis, not only must the sac be removed but also the tunica vaginalis excised as completely as possible, otherwise a post-herniorraphy hydrocele may form. The rationale of such a procedure is explained by the work of Allen and Rinker,[4] who demonstrated that in congenital hydroceles the parietal tunica vaginalis is thickened and the normal subserous lymphatic plexus is absent. The absorption from such a tunica vaginalis is inadequate because of underdevelopment.

In cases of recurrent hydrocele, factors which caused the primary hydrocele must be considered first. The original hydrocele must have been caused either by interference with drainage along the spermatic cord or delay in absorption from the tunica vaginalis. In either case the tunica vaginalis must be excised as widely as possible in order to eliminate a closed cavity in which fluid is trapped. If the excision of the tunica vaginalis is inadequate, regeneration of endothelial cells will close the defect again and a hydrocele wall may be completely reformed. The hydrocele fluid will be trapped in a closed cavity from which absorption is poor because the lymphatics were damaged during the operation.

In this series eight recurrent hydroceles were operated on and in each case the hydrocele wall, lined by glistening endothelium, had completely reformed. In some cases the hydrocele wall was very thin and much like a normal tunica vaginalis. At the second operation the hydrocele wall was resected as widely as possible in order to prevent the future formation of a closed membranous cavity. Pathological examination of the reformed hydrocele wall revealed patches of newly regenerated endothelial cells lining its interior. Wide excision of the tunica vaginalis is therefore imperative in order to prevent recurrent hydrocele.

SUMMARY

A series of 871 cases of hydrocele associated with inguinal hernia is presented. The relationship between hydroceles and hernias is analyzed.

CONCLUSIONS

1. About 5% of inguinal hernias were associated with hydroceles of the testicle on the same side.

2. Surgical treatment was 100% effective in hydroceles uncomplicated by inguinal hernias, but only 91.3% effective in hydroceles complicated by inguinal hernias.

3. Large hydroceles obscure small inguinal hernias in at least 60% of such combined cases.

4. Lymphatic damage along the spermatic cord must be avoided in order to prevent a post-herniorraphy hydrocele.

5. Endothelial cells of the tunica vaginalis are capable of regenerating and causing a hydrocele to reform after combined operation for hernia and hydrocele.

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CLINICAL AND LABORATORY STUDIES IN PATIENTS WITH RESPIRATORY DISEASE CAUSED BY ADENOVIRUSES (RI-APC-ARD AGENTS)

The clinical features in 45 laboratory-proved cases of respiratory illness of RI virus etiology among hospitalized military personnel are described by Dascomb and Hilleman (Am. J. Med., 21: 161, 1956).

Type 7 RI virus was the sole or predominant agent among the cases studied. The patients had a basic syndrome of fever, pharyngitis and cough, often accompanied by conjunctivitis, rhinitis, otitis, laryngitis, tracheobronchitis, bronchiolitis or pneumonitis, and constitutional symptoms.

These cases of RI etiology belong to the syndromes designated as undifferentiated acute respiratory disease, pharyngo-conjunctival fever, non-streptococcal exudative pharyngitis, bronchitis resembling atypical pneumonia and primary atypical pneumonia unassociated with the development of cold or streptococcus MG agglutinins. Collectively, the cases belong in the syndrome of febrile catarrh described by Stuart-Harris et al.

The "typical" common cold and primary atypical pneumonia associated with the development of cold and streptococcus MG agglutinins were not among the entities caused by the RI viruses.